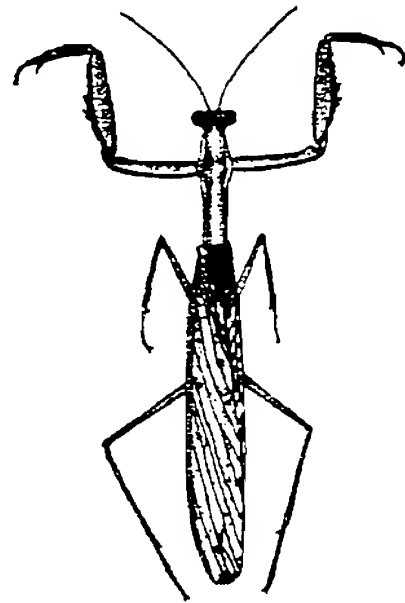


Mantis Study Group Newsletter 2

November 1996

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Editorial

Welcome to the second *MSG Newsletter*. As you will have noticed, this is a bumper issue. Providing there are enough contributions, we expect to produce one large newsletter like this one and three of a similar size to the first newsletter (16 pages) during 1997.

Some of you may have noticed that in the last newsletter I said that membership had reached 50 and the membership list had almost 60 on it. You may have wondered why I didn't say almost 60 members, the simple answer is that seven people joined during the five days between me posting the Newsletter to Kieren and Paul sending him the membership list - Yes, the Group is growing that quickly! Paul Taylor tells me that we currently (30th October) have 91 members and, with enquiries coming in regularly, we should reach the 100 mark by the end of the year.

I have three apologies to make. Firstly, I forgot to invite people to send me their comments on the *Newsletter*, I would like to hear which bits you like / do not like / want changed etc. Secondly, apologies to Steve Clark who appeared in the last *Newsletter* as Steve, Stephen, and Steven; he has no preference between Steve and Stephen, but points out that Steven is wrong! Thirdly, I forgot to mention that Kevin Sargent is acting as the membership secretary for the USA.

MSG subscriptions for next year will be: UK £6.50, rest of Europe £7.50, Worldwide £9.00. Because we have some money left over, anyone who joined in 1996 will get a reduction of £1.00. If we have worked it out correctly this will provide enough income to produce and post out four *Newsletters* without having to limit the number of pages too much!

I am pleased to be able to say that I have had a good response to my request for *Newsletter* items. Remember to get writing again for the next *Newsletter* which should be out in February; try to get articles to me by the end of December so I have time to process them check any queries with you if necessary.

Change of address

Kieren Pitts is no longer at the address given on page one of the last *Newsletter*. His new address was given on the address list: 39, Adkin Way, Wantage, Oxon, OX12 9HN, UK.

Membership Renewals - Paul Taylor.

Members should please note that renewals are due on January 1st 1997. Enclosed with this newsletter will be a renewal form. Members who joined at the formation of the Group in

May will notice that £1.00 is credited against their 1997 dues. This is because only two newsletters were published, and after working out the accounts for 1996, we will have a small surplus.

Unfortunately, the subscription for 1997 has had to be increased. This is to cover the costs involved in the printing and postage of the newsletters. If membership continues at its current level, we should have a small surplus, which will allow the Group to exhibit at future Entomological Shows. Membership subscription is set at the following levels for 1997: £6.50 - U.K. members; £7.50 - other European members; \$15.00 - USA member; £9.00 - other Overseas members.

Payment of Subscriptions: Since we originally set out the method of payment of subscriptions, it has been found simpler than was anticipated to exchange foreign currency. Therefore, there is no longer any need to add on any payment for foreign exchange. Members should send their subscription direct to me, except for members in USA (see below).

Members in the USA should send a cheque for \$15.00 to Kevin Sargent, Dept. of Communication Studies, Furman University, Greenville, SC 29613, U.S.A. All cheques (including those sent to Kevin) should be made payable to the *Mantis Study Group*.

European members may pay by Eurocheque. All other Overseas members should pay by cheque, made out in Sterling, drawn against a British Bank.

Members, if they so wish, may pay in their own currency in cash (banknotes only - no coins), but please remember, *this is entirely at your own risk*. Do not add anything extra as I have managed to arrange matters so that we are not charged for currency exchange.

I hope all current members will renew their membership, and will look forward to receiving their subscription in due course.

1996 Accounts - Paul Taylor.

If any member wishes to view the accounts for 1996 at the end of our first year, would they please send a stamped, addressed envelope to me. A brief resumé of our accounts will be published in the next *Newsletter*.

Membership list & E-mail - Paul Taylor.

With each Newsletter, an update to the membership list will be printed. Members are reminded that they must not allow the list to be used by other persons. It has also been suggested that a list of E-mail numbers be printed. If members are on the E-mail, or can be faxed, then please E-mail, or write, to me with your address. For the next *Newsletter* we will have a list of E-mail addresses, and fax numbers.

Membership Secretary E-mail: 100701.766@compuserve.com

On-line information - Paul Taylor.

Members who have access to the Internet may be interested in accessing Kevin Sargent's Mantis page. This is a very interesting page with a wealth of information about Mantids, joining the Group, and associated pages as well. There is also Gordon Ramell's Home Page. For more information:

Kevin's page: <http://ns9000.furman.edu/~dksargen/MF.htm>

Gordon's page: <http://www.ex.ac.uk/~gilramel/welcome.html>

Posting mantids - Mike Jope.

When sending mantids through the post I have found the method used by ELS (Entomological Livestock Supplies) to be most satisfactory. Putting the mantis in a collapsed plastic bag, inside a cotton-wool lined polystyrene box prevents it from being bounced around in the post. One method that seems very undesirable is sending it in a container with a piece of damp cotton wool in with it; the cotton wool will roll around in the container and pummel the poor mantis. Another drawback is that if the wings extend over the abdomen, excessively damp conditions cause their wing tips to go very dark and become damaged.

Mating mantids - Mike Jope.

When mating mantids I usually place the male, when he is ready, on the female's back. I hand feed her if she seems a little too interested in him, this usually occupies her long enough for him to start mating. I keep the male's container next to the female's so that he can see her and get used to the idea beforehand, then when he starts to flex his abdomen he shows he is ready. A problem I have had several times recently with *Tenodera sinensis* is that the males are sometimes larger than the females. This causes the problem that he has to be a contortionist to mate with her, having to bend his abdomen almost double to manage it. When I have managed to mate a pair like this it damaged the female and she died after laying a malformed ootheca.

Cheap cages for nymphs - Phil Bragg.

Containers for young mantids are always a problem! I use small (150g) yogurt pots, or small plastic cups. I put one twig in each pot (diagonally) and nothing on the bottom of the cage. I put cling-film over the top and fix it on by wrapping a strip of sellotape round the rim of the pot. I then put a strip of sellotape across the top of the pot and cut a 1cm diameter hole through the sellotape and clingfilm (the sellotape stops the film from tearing. The hole is used to drop the food through; the hole is closed with a small piece of sponge or cotton wool.

Parthenogenesis in *Miomantis* - David Yager.

I know of two published reports of parthenogenesis in mantids. A 1925 study (Adair, E.W. "On parthenogenesis in *Miomantis savignyi* Sauss." *Bull. Soc. ent. Egypte* 8: 104-148.) showed that it occurred quite frequently in one species of *Miomantis*, with many of the resulting females reaching adulthood. The species is not however exclusively parthenogenetic, and it would be very interesting to know the factors which induce it to switch from one reproductive mode to the other. I have reared several species of *Miomantis* (including *M. savignyi* - which I think is the same as *paykullii*?) in the lab for many generations and seen only occasional nymphs appearing from unfertilised egg-cases; those nymphs rarely reach adulthood.

One species of mantis is known to reproduce only through parthenogenesis, and only females have been collected. That is *Brunneria borealis* Scudder, a large mantis from the southern USA (White, M.J.D. "Chromosomes of the parthenogenetic mantid *Brunneria borealis*." *Evolution*, 2: 90-93). It is especially interesting that four other species in the genus have normal sexual reproduction. There are other species for which only females are known, but they may represent sparse collecting rather than a true absence of males.

[Editor's note: The original description of *Miomantis savignyi* Saussure, 1872 included a description of both the male and the female, but the specimens described were subsequently treated as different species. Giglio-Tos (1927) lists Saussure's male as a *M. paykullii* Stål,

1871, and his female as a *M. pharaonica* Saussure, 1898. Giglio-Tos makes no mention of Adair's paper so if the species are different, Adair may have had either *pharaonica* or *paykullii*. However, in 1967 Ragge & Roy listed *pharaonica* as a synonym of *paykullii*, and regarded *savignyi* as the same species (see Bruno Meriguet's comments below)]

Parthenogenesis in mantids - Bruno Meriguet.

There are some known cases of parthenogenesis in mantids. Adair (1924) worked on parthenogenesis at the beginning of the current century in Egypt. The species that he studied was *Miomantis savignyi* Saussure, 1873. He raised two generations of *Miomantis* and he wrote the following conclusions:

1. The length of virgin females was almost equal to the paired females.
2. In all the unfertilised females (51) 30% made no oothecae, 55% made less than 12 and 15% made 13-21 oothecae.
3. The size of oothecae laid by unfertilised females may be longer than 25mm in 6% of cases, oothecae from paired females never exceed 25mm.
4. Paired females laid oothecae 8-11 days after the last moult. Unmated females laid 14-28 days after the last moult.
5. The number of young hatching from unfertilised females never exceeds half the normal number and may be reduced to zero.
6. Hatching is generally simultaneous in fertilised oothecae. In unfertilised oothecae the young hatched over 2-5 days and 10-20% fail to liberate themselves from the hatching sheath.
7. The incubation period is more important for unfertilised oothecae than fertilised (2-3 days longer in the best periods).
8. A large number of young failed the first moult, and he lost 50% of the young at each moult.
9. All adults he obtained from unfertilised oviposition were females. He did not look at the immature stages. In fertilised oothecae he found equal numbers of males and females.
10. There are usually 6-8 moults during the immature stages.
11. *Miomantis savignyi* may pass the winter months in any stage, young, adult, or oothecae; the postembryonic stage varies from 2-8 months, and the adults vary to the same extent.

In his conclusion Adair wrote that he didn't think parthenogenesis was a natural event; in nature the females are paired, the parthenogenetic event is an accident caused by experimental raising. At the beginning of the article he suggested that the same could be observed in *Sphodromantis* sp.

At the beginning of 1996 I found in Giglio-Tos (1927) that *Miomantis savignyi* has been described as *Miomantis paykullii* Stål, 1871. When I talked to Mr Roy of the French National Museum of Natural History he told me that he thinks *M. savignyi*, *M. pharaonica* and *M. paykullii* are the same species, with the spot on the fore legs showing polymorphism. An explanation of the nomenclature of this species is given by Ragge & Roy (1967: 627-629), they concluded that *M. savignyi* Saussure, 1873, *pharaonica* Saussure, 1898, *paykullii* Stål, 1871, and *sengalensis* Schulthess, 1899 are all the same species.

A few days later I obtained two females, and two oothecae of *M. paykullii*. I have since reared 60 young to make some experiments on the parthenogenesis. I am a student in Biology and am preparing a report about this phenomenon for my fourth year at university.

At the same time, one of my friends sent me a dozen first and second instar nymphs.

He said that his only female has laid oothecae without a male. The young do not eat *Drosophila* (too big). I have two older nymphs and am waiting for the final moult. It seems to be a *Hoplocorypha* sp, this genus is not clear.

One parthenogenetic species is already known: *Bruneria borealis* Scudder; as pointed out by White in 1948, it is a North American species which only has females. I have no other information on it.

I am interested in all species which may be parthenogenetic, and I am searching for species to rear. If other MSG members have information I would like to hear about it.

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- Giglio-Tos, E. (1927) Orthoptera, Mantidae. *Das Tierreich*, **50**. [in French].
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Parthenogenesis in *Stagmatoptera* and *Tenodera* - Mike Jope.

I was interested to read about parthenogenesis in *Miomantis* and *Sphodromantis* in the last MSG Newsletter. A few years ago I had a number of *Stagmatoptera hyaloptera* (Perty), "Argentine White Crested Mantids"; one of the females which I had reared laid an ootheca when she was unmated and to my surprise six nymphs emerged from it; normally there seemed to be about 110 nymphs per ootheca. I have also had five nymphs hatch from a *Tenodera sinensis* ootheca which I had believed was infertile.

Parthenogenesis again - Tom Larsen.

I am a member of a Danish society for invertebrates which issues a small magazine every two months; I have just written an article for the coming issue on my experiences with parthenogenesis in mantids.

I have experienced it with two species of *Miomantis*: *M. ehrenbergi* and *M. pharaonica*. From *M. ehrenbergi* I got 23 nymphs but only three survived, all female. I have oothecae from these and, like Steven Dickie, I am waiting to see if the parthenogenesis is continued; I do not think it will be since the oothecae are now 4-8 weeks old.

With *M. pharaonica*: 12 nymphs hatched, one survived and, surprisingly, turned out to be male. I will now try to find out if he is fertile. One of my adult females has made an ootheca which looks very fertile, she has made it on clear plastic and you can see the eggs from the back; she has not been copulated yet.

There are two other examples of parthenogenesis that I know of in Denmark. The first was in mid 1993 and involved *Sphodromantis viridis*. Four nymphs emerged, very weak and the last was crippled and died after four moults. The other example was in early 1996 with *Hierodula parviceps*; well over 100 nymphs died (or were eaten by the mother) when the owner could not get food for them.

Mantis Rearing Techniques: Mass rearing and Food - Jon Copeland.

Between 1968 and 1978, Paul Krombholz (then of Tufts University) and I (then of State University of New York) quite independently developed methods for raising large numbers of mantids to be used in physiology and behaviour experiments.

The mantids were fed instar-specific food. *Drosophila virilis*, *Musca domestica*,

Phormia regina, and *Sarcophaga bullata* were used. Instars 1-3 were fed on *Drosophila*, instars 3-5 were fed *Musca*, and all other instars were fed some combination of *Phormia* and *Sarcophaga*.

Drosophila larvae were raised on a mixture of moistened dry cat food and wood shavings. *D. virilis* was used because it was very photopositive and thus large numbers could be collected easily. The other three flies were raised on a mixture of wet dog food and wood shavings. All flies pupated on fresh wood shavings. The air-sifted pupae were moved to adult fly cages. Adult flies were fed sugar cubes and water and given liver (moistened dry cat food for *Drosophila*) for oviposition. The cat and dog foods with the highest protein content were chosen.

We reared mantids in communal cages (20-50) individuals per cage at all instars. Instars 1-3 were raised in gallon (about 4.5 litres) clear glass pickle jars stuffed with slender twigs. Larger instars were raised communally in 2m x 0.5m x 0.5m screen cages that were covered with clear plastic. The large cages were filled with branches and twigs and were illuminated from above by two fluorescent lights. Adult males were separated from adult females following the final moult and lived in same-sex communal cages.

Communal living was made possible by providing an abundance of flies one or two times per day, i.e. mantis hunger level was kept low (this meant that we kept sugar cubes for the flies in the bottom of each cage). On the days that moulting would occur, fewer flies were introduced. Using this extremely-well-fed-mantis technique, moulting occurred regularly every 6-7 days, and with fewer flies in the cage, fewer mantids were jostled during moulting.

The deaths that occurred were usually due to moulting tragedies. Whenever cage humidity got too low moulting problems occurred. Thus cages were well sprayed once or twice per day to keep humidity high. The actual humidity was never measured, but it must have been close to 100% for at least 2-3 hours after each spraying.

The high humidity inside the mantids cages was a two-edged sword. High humidity reduced the losses due to moulting; however, high humidity could promote the growth of a cockroach mite. This mite could interfere with mantis moulting. There was a fine line between too much and too little moisture.

Mantids were raised on a 18:6 light to dark cycle, and at approximately 20°C. It took about six weeks to go from 1st instar to adult. Adults could live as long as three months. Immediate post-ovipositional feeding of a female usually promoted the production of a second egg case and could lengthen the female's life.

This was a labour intensive way of raising a large number of mantids, but it was hugely successful. It took about three hours per day (half for fly culture, and half for mantis culture) to raise about 300 animals in various stages of development. *Tenodera sinensis*, *T. angustipennis*, and *M. religiosa* were raised using these techniques.

What I hope may be new and different to folks interested in raising mantids for fun, science, or profit, is the notion that you can mass rear what appears to be nutritious food for mantids and that you can mass rear these animals in communal cages. The few names that I recognize on the membership list have already heard this "culture methods" story, but perhaps it will be interesting to others of you in the MSG.

Mating mantids: cold males with hot females - Jason Church.

I have used the following method with a species of *Sphodromantis*. Any other mantis used should have the tank increased or decreased according to the size of the mantids.

After the final moult, the male should be well fed for about a week, and humidity should be kept high. About a week after its final moult the male is transferred to a glass tank, 15cm x 15cm x 15cm, at approximately 20-23°C, for 5-7 days. I prefer to use glass rather than plastic because it retains humidity better. The tank is covered with an opaque material so that no light filters in. There should be no branches or twigs in the cage, this allows him to capture his food more easily. The tank's substrate should consist of irish moss, peat, or wood chips; I never use vermiculite for mantids since it is like quicksand to them.

The female is kept in a larger tank, 30cm long, 15cm wide, 20cm tall, with the same substrate as the male's cage. Two branches should be placed in the cage, positioned diagonally, adjacent to each other. The cage should be heated to 27-29°C, using a heating pad and thermostat.

After the 5-7 day wait, place the female at one end of the tank on a branch. Place the male at the other end. At first nothing may happen, but sometimes there is a courtship display. You should sit and watch until coupling is complete, this could take up to two hours. The female will usually approach the male and turn her back on him, enabling him to quickly jump on her back. Once on her back, the male will twist and contort his abdomen, pushing his sexual organ onto hers. Mating may last for 12 hours and they should not be disturbed. After mating has taken place you will usually find the male trying to get out. Do not worry about the female biting the male's head whilst mating since his body stays alive a long time after; this is a sign that the female has not been fed enough.

I have only had one upset, when a male decided to breed with a branch rather than the female. I think the cooling down process slows the male's movements allowing the female to mate when she is ready.

A little knowledge is a dangerous thing

or What not to do / Learning by experience - Paul Dowthwaite.

1. A little knowledge is a dangerous thing.
Armed with zero experience and a little knowledge, I purchased my first ootheca. I had no idea of the species, were there different ones? I was rather amazed when some time later tiny creatures began to emerge. But wait a minute, mantids eat each other.
2. Don't panic.
They must be separated. Carefully catching them as they emerged on their threads I placed them in separate containers complete with moist substrate and a stick to climb. Of course they never managed to escape from their membrane and died.
3. If at first you don't succeed.....
Once I had overcome my embarrassment, a year or so later, and read a book, I decided to try again. Another ootheca, this time I knew the species, *T. sinensis*. Quite an expert.
4. A little knowledge is a dangerous thing.
Once again they emerged from the ootheca, but this time I knew to leave them alone. I left them alone in a large cage, previously used for phasmids, where I fed them regularly on fruit flies. Success, a thriving colony of about 50 nymphs. Came the time to separate them also came the problem of containers. They need a humid atmosphere, coffee jars with drilled lids seemed ideal, damp substrate and a stick to climb. As they grew I transferred them to larger jars. Not wishing to dwell on my failure and slowness to respond, their number slowly dwindled. I continued to loose

them as they failed to emerge from their moult, usually due to them falling or touching the floor. Despite the stick, they insisted on trying to shed their skin hanging from the side of the container: they couldn't. Different container? But unfortunately it was too late.

5. South facing windows are not a good idea.

The only mantids that remained were the two which had escaped very much earlier. They seemed very happy living on plants at opposite ends of my "warm room". They caught flies, I fed them crickets by hand and provided occasional water by spraying the plants. One of them died while emerging from its final moult when the sun broke through the clouds and dried it out.

6. It's worth it in the long run.

My final, solitary, female still survives and I am continually amazed by her. Although she does move around the room she can usually be found in the same place on her geranium. She watches and seems expectant of food when I feed her by hand. Occasionally she gets impatient and will fly down to the tub of crickets I am using to feed my spiders and help herself. She is totally unconcerned if I have to move her because she is in the way, and simply flies back to resume feeding some minutes later.

7. I'm ready to try again. Any unwanted oothecae out there? I really think I can do it this time!!!

Collecting on the cheap - Liz Newman

I went to Kenya with the intention of collecting phasmids. I'd found a very cheap package tour that gave me one week by the coast and one week on safari - camping out in the game parks, not staying in lodges. I hadn't tried collecting abroad before, and I felt very intrepid.

The first surprise was the lack of any fences round the campsite at Tsavo East, which was completely deserted - unless you count a troop of baboons. The second surprise was the elephant that turned up to inspect the new arrivals. The third was when a first instar mantis dropped out of a tree and onto my dinnerplate. This suited me just fine, but the other members of the party found the proximity of the wildlife rather alarming, although they were spotting insects for me by the end of the trip.

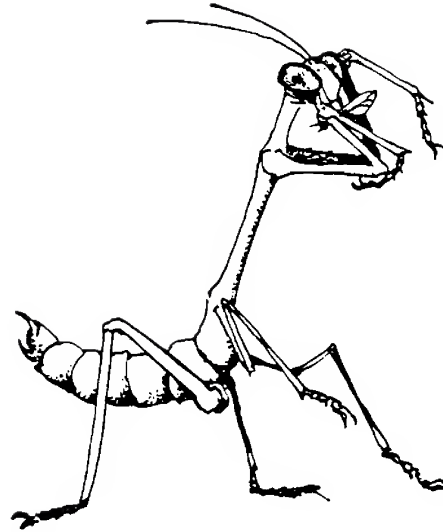
The equipment I took with me was one collapsible net cage, several small plastic containers, a torch, a bug-box (plastic container with a vertical sliding door for quick action) and a hand lens. Subsequently I've added a pooter and a sweepnet to this list. As I only ever found one fully-grown mantis, the small containers worked very well - perhaps the reason nymphs are so much easier to spot than adults is because they move so quickly, and our eyes register movement before form. They're easier to find than phasmids; I didn't see a single stick insect for the whole holiday.

The second mantis was hiding in a thorn bush at Amboseli, and it took me a painful half-hour of glimpsing it, losing it, glimpsing it and losing it again before I managed to catch it. I finally knocked it off its twig and into one of the containers. This too was a first instar of a different species, later identified as either *Parasphendale costalis* or *P. africana*. The third mantis was climbing up someone's tent, and the fourth was discovered perching on a stem of grass. This last one was an adult male, and it only lived for a few days.

Collecting is a state of mind; you get accustomed to looking for tiny movements when you're doing something else - go looking for mantids and you'll find a millipede or a bush cricket or a lizard. Once captured, mantids will live in a confined space for a few days with

no problem - but you do have to feed them. The good news is that they'll eat practically anything that moves, as long as it's the right size.

The mantids I caught in Kenya were the first I had ever kept, and so it was learn-as-you-go. I didn't have much success initially, all I could find as food were some small beetles which seemed to have some powerful chemical defences. The mantis would look very interested, stalk the beetle until it got within striking-range - then the strike would be aborted halfway through, too quickly to see what the beetle actually did in pre-emptive action. The mantis would then back off, and it never made the mistake of going for the same beetle again. I didn't find any suitable food until I reached the hotel near



Mombasa. There were extensive gardens, and some small metallic-green flies that liked the flowers. I would spend hours walking round the flowerbeds looking for flies that had landed on a flat leaf - the trick was to bring down one of the plastic containers smartly on top of the insect, slide it to the edge of the leaf and get the lid on before the fly escaped. I got some very strange looks from the other hotel guests. The mantis to be fed would be put in the net cage, and the fly released inside. To my astonishment the fly was history within a few seconds; I managed to feed all three mantids quite successfully this way for a week.

Collecting in Africa can be dangerous. Wandering through the bush at night with only a flashlight for defence is not a good idea, and the bush starts the moment the tents are out of sight. One night some hyenas investigated the cooking pots which was noisy and unnerving, and there were large doggy footprints everywhere the next morning. On another occasion I saw a hyena taking a short-cut across the campsite carrying a leg of something, and we heard a leopard coughing in the bushes although I never saw it.

My safari used an Izusu bus, which has a lot more space than a Toyota, and the net cage could remain set up. The driver - who was also the guide - was amused at first. Then he got interested. Watching animals was part of his job, and he'd just never paid attention to anything smaller than a dik-dik (*Rhynchotragus kirkii*) before. He became an entomological covert with remarkable speed.

Two of the three mantids survived to adulthood. The third nymph - which reached third instar - was the most interesting. It was a tiny twig mimic, dark brown and very knobbly, with a horned head and exfoliate extensions. The problem with collecting mantids in the wild is that I've never found two of the same species, let alone two of opposite sexes. And sexual dimorphism is against me - I'm not sure I'd be able to match male and female. Although I looked for oothecae I never found any - a pity, as this would seem to be the best collecting strategy by far.

I've also learnt a great deal about catching flies. If I only have a couple of mantids, I find it's not worth buying food. It's surprising how quickly you find out where the flies rest, which ones are around at a particular time of year, which ones are worth chasing. Mantids really will catch just about anything that moves; I had a *Sphrodromantis* that particularly liked wasps, but I've never found one that will eat a beetle. I use little strips of

liver as a stop-gap when nothing else is available, the eating reaction in mantids is so innate that the jaws start working the moment something suitable touches them.

The following year I went to Costa Rica, as I had a friend there whose house I could use as a base. Although I saw lots of phasmids I only caught one mantis. This was in the grass at the roadside in the middle of San Jos; local museums are an excellent place to start, for you can get an idea of what's around and where to look for it. (Thanks are also due to Allan Harman, who gave me precise locations for phasmids. If you know someone who's been where you're going, ask them first - it can save a lot of time and effort!) My trips have been very amateur affairs, but I've had a lot of fun.

Perilous ecdyses - Dorothy Newman

I have always wondered whether it is worthwhile helping insects through difficult moults; I had a fourth instar female dead- flower mantis, (the scientific name of which I don't know, but she was black with lots of exfoliate extensions) whom I found lying in a struggling heap at the bottom of her cage halfway through an ecdysis. She had been there long enough for the skin to have started drying, and her body to have become twisted, so even if I had "hung her up" again she would not have completed the shed and would have died.

Being a devoted owner I then spent a good two and a half hours meticulously pulling off the dead skin with the aid of a pot of water, some paintbrushes, tweezers, a needle, and a stereo microscope (magnification up to 20x). There were places where the skin had to be cut, to free legs which would otherwise have started to harden in the wrong shape, and the really difficult bits were round the eyes and antennae. It would have been much easier if I had found her earlier, as I could have kept the skin moist and supple, instead of having to try and prise off hard bits which were stuck to the mantis beneath. (The exfoliate extensions just made the job more complicated).

To my profound surprise she survived. Her head was bent over and the whole of her thorax and legs were twisted in such a way that she couldn't move properly, let alone catch any prey, but she could just about hang upside down from a twig and walk along it a little way. Having come thus far I couldn't let her die now, so I rigged up a complicated feeding-machine strategically balanced just within reach of her jaws. The contraption consisted of a piece of card folded over and stood on its end like a Christmas card, a glob of blue-tack stuck to it at the correct height, and a pin stuck in this point-outwards. Thin strips of liver could then be speared by the pin and kept in place whilst she ate, and the height and distance could be altered if she'd moved along her twig. I kept her alive for some considerable time, hoping that her next ecdysis would sort out some of the deformity, but sadly she died in the middle of the next shed which was during the night.

Information wanted - Michael Poteser

I am part of a study team involved in research into mantis behaviour. The behavioural repertoire of different mantis species is variable in quality and quantity. For our research we need mantis nymphs which are highly active i.e. have a high motivation to run and jump, and they have to show a special behaviour that can be described as a side-to-side movement of the prothorax and the head. Our question is: Does anyone know a highly active mantis species in which nymphs show these movements very often. We would be grateful for any information. Please send any information to: Michael Poteser, Institute of Zoology, Karl-Franzens-Universität Graz, Universitätsplatz 2, 8010 Graz, Austria.

Keys to genera of the family Mantidae (excluding Mantinae)

by David Oliveira, 62 Coombe Lane West, Kingston, KT2 7BY, U.K.

As with the keys to families and subfamilies in the last *MSG Newsletter*, the following keys are based on translations of the works of Giglio-Tos (1927, Orthoptera, Mantidae. *Tierreich*, 50: 1-707) and Beier (1968, Mantodea (Fangheuschrecken). *Handbuch der Zoologie*, 4(2)2/12: 1-47) and follow the classification of Beier with some details filled in by reference to Giglio-Tos. The same limitations apply: the key is entirely derivative, not based on any original observations by me and I may well have introduced errors in the translation, in addition to any errors in the original sources. There are also, of course, the underlying taxonomic difficulties.

Genera described since Beier (1968) are not included.

Any comments, criticisms or additions would be very welcome.

Family Mantidae

The subfamilies of Mantidae are treated here in alphabetical order. For the key to the 21 subfamilies see pages 12-14 of *MSG Newsletter* 1. Keys to the subfamily Mantinae will appear in the next *MSG Newsletter*.

Subfamily Amelinae

Key to tribes

- 1. Lateral ventral edge of anterior femora smooth between the spines. Dystactini
- Lateral ventral edge of anterior femora rough, or with small spines, between major spines. Amelini

Tribe Dystactini

Key to genera

- 1. Pronotum trefoil shaped, with sharp angles to the lateral bulges. 2
- Pronotum more or less elliptical, the lateral bulges rounded. 4
- 2. Vertex above antennae bicornuate. *Achlaena*
- Vertex above antennae simple. 3
- 3. Prozone of pronotum with two elevated keels in front of the supracoxal groove. *Achlaenella*
- Prozone of pronotum smooth. *Dystacta*
- 4. Metazone of pronotum keeled. *Rhachimantis*
- Metazone of pronotum not keeled. 5
- 5. Anterior tibia with 9-10 external spines. 6
- Anterior tibia with 6-8 external spines. 7

6. Anterior border of elytra of male edged in white. *Betamantis*
- Anterior border of elytra of male not edged in white. *Chroicoptera*
[Probably includes *Alphamantis* Giglio-Tos]
 7. Some of the large preapical medial spines of the anterior femora of the male much stronger than the others. Pronotum of female almost circular, the edges strongly spined. *Ligaria*
[Probably includes *Ligariella* and *Ligariona*]
- The large medial spines of the anterior femora of the male of similar robustness. Pronotum of female much longer than wider, the border more or less toothed, not spined. 8
 8. Head much longer than wider. *Parentella*
- Head much wider than longer. *Entella*
- * Probably includes *Metentella* and *Micrentella* Giglio-Tos.
* Also included by Beier: *Entelloptera* Beier, and *Pseudentella* Beier.

Tribe Amelini

Key to genera

1. Pronotum trefoil shaped, with sharp angles to the lateral bulges. 2
- Pronotum more or less elliptical, the lateral bulges rounded. 4
2. Anterior tibia with more than 7 external spines. *Dystacula*
- Anterior tibia with 7 external spines. 3
3. Lateral lobes of pronotum rounded. Antennae thickened. *Gonypetella*
- Lateral lobes of pronotum sharp. Antennae slim. *Telomantis*
4. Hind wings brightly coloured. 5
- Hind wings not coloured. 6
5. Anterior tibia with 9 external spines. *Compsomantis*
- Anterior tibia with 7 external spines. *Opsomantis*
6. Supra-anal plate large, at least as long as wide. 7
- Supra-anal plate very small, wider than longer, transverse. 10
7. Posterior metatarsus much shorter than the two following segments taken together. 8
- Posterior metatarsus longer than the two following segments taken together. 9
8. Wings well developed in male, short in female. *Ameles*
- Wings short or absent in both sexes. *Pseudoyersinia*
9. Posterior metatarsus much shorter than the rest of the segments taken together.
. *Yersinia*

- Posterior metatarsus at least as long as the rest of the segments taken together.
 *Litaneutria*
- 10. Posterior metatarsus longer than the rest of the segments taken together. 11
- Posterior metatarsus not longer than the rest of the segments. 12
- 11. Frontal sclerite almost square. *Amantis*
- Frontal sclerite transverse. *Gimantis*
- * Probably also included here: *Cimantis* Giglio-Tos, *Dimantis* Giglio-Tos, *Eumantis* Giglio-Tos, and *Elmantis* Giglio-Tos.
- 12. Frontal sclerite not larger horizontally than vertically, the superior border very bowed. *Gonypeta*
- Frontal sclerite more or less as large horizontally as vertically, the superior border less bowed. 13
- 13. Metazone of pronotum with two tubercles in the middle. *Myrcinus*
- Metazone sometimes bosselated but not with two tubercles. 14
- 14. The first two external spines at the base of the anterior femora very close to the rest.
 *Armene*
- The first two external spines at the base of the anterior femora not very close to the rest. 15
- 15. Anterior femora smooth on external surface. *Armeniola*
- Anterior femora granular on external surface. *Bimantis*
- * *Elaea* was transferred to Amelinae from Liturgusinae by Ragge and Roy 1967.
- * Also included by Giglio-Tos but possibly not Beier: *Amphecostephanus* and *Memantis*.
- * Also included by Beier but not by Giglio-Tos: *Bolbella* (Not clear why. It only has 3 discoidal spines), *Haldwania*, *Congomantis*, *Apteromantis*, *Yersiniops*, and *Holaptilon*.

Subfamily Angelinae

Key to genera

- 1. The first discoidal spine of anterior femora longer than the second. 2
- The first discoidal spine of anterior femora shorter than the second. 3
- 2. Cerci very expanded, foliaceous. *Angela*
- Cerci not expanded. *Thespoides*
- 3. Internal apical lobes of anterior coxae adjacent. *Euchomenella*
- Internal apical lobes of anterior coxae divergent. 4
- 4. Anterior tibia short, scarcely one quarter the length of the anterior femora.
 *Leptocola*

- Anterior tibia longer, approximately one third the length of the anterior femora. . . 5
- 5. Supra-anal plate rounded or trapezoidal. *Stenopyga*
- Supra-anal plate triangular, sharp. *Agrionopsis*
- * Treated by Giglio-Tos as separate genera, but I suspect incorporated into *Stenopyga* by Beier: *Stenopygella* and *Agriomantis*.
- * Also included here by Beier: *Mythomantis* and *Sinaiella*.

Subfamily Caliridinae

Key to genera

- 1. Internal apical lobes of anterior coxa adjacent. *Deromantis*
- Internal apical lobes of anterior coxa divergent 2
- 2. First discoidal spine medial to the second *Leptomantis*
[Giglio-Tos also has *Aetaella* Hebard]
- First discoidal spine behind the second. 3
- 3. Oblique veins of discoidal region of elytra not very bowed. *Caliris*
- Oblique veins of discoidal region of elytra very bowed and almost transverse.
. *Gildella*

- * Also included by Beier: *Hebardia* Werner, and *Hebardiella* Werner.

Subfamily Choeradodinae

Contains a single genus: *Choeradodis*.

Subfamily Compsothespinae

Single genus: *Compsothespis*.

But possibly also includes *Cliomantis* Giglio-Tos.

Subfamily Deroplatinae

Key to tribes

- 1. Vertex with conical projection. Parablepharini
- Vertex without projection. Deroplatyini

Tribe Parablepharini

Contains only a single genus: *Parablepharis*.

Tribe Deroplatyini

Key to genera

- 1. Eyes rounded. *Deroplatys*
- Eyes pointed. *Brancsikia*

Subfamily Haaniinae

Key to genera

1. One dorsal spine at apex of anterior tibia. *Astape*
- Two dorsal spines at apex of anterior tibia. *Haania*

Subfamily Iridopteryginae

Key to tribes

1. Claw groove approximately in middle of anterior femora. Hapalomantini
- Claw groove in proximal part of anterior femora, often near the base. 2
2. Metazone of pronotum at most with a fine linear medial keel.
. Iridopterygini
- Metazone of pronotum with a well defined and elevated medial keel.
. Tropidomantini

Tribe Hapalomantini

Key to genera

1. Anterior femora with 1-2 discoidal spines. *Tarachina*
- Anterior femora with 3 discoidal spines. 2
2. Elytra without false veins between the longitudinal veins. *Bolbe*
- Elytra with such false veins. 3
3. The fifth or sixth external marginal spine of the anterior tibia from the apex longer than the rest. *Hapalomantis*
- All the external marginal spines of the anterior tibia (with the exception of the apical) about the same length. 4
4. Mediastinal vein of the elytra very close to the radial veins, not dividing the costal area. *Bolbula*
- Mediastinal vein of the elytra distant from the radial veins, dividing the costal area into two parts. *Bolbena*

* Also included by Beier: *Microbolbella* Sjöstedt.

* Also included by Giglio-Tos: *Bolbella* Giglio-Tos (see Amelinae below), *Bolboda* Giglio-Tos, *Bolbira* Giglio-Tos, *Eubolbe* Giglio-Tos.

Tribe Iridopterygini

Key to genera

1. Posterior radial vein of elytra not considerably separated from first branch of anterior ulnar vein. 2
- Posterior radial vein of elytra considerably separated from first branch of anterior ulnar vein. 6

2. Frontal sclerite at least three times as broad as high. 3
- Frontal sclerite scarcely twice as broad as high. 4
3. Posterior border of pronotum simple *Micromantis*
- Posterior border of pronotum armed with two long spines. *Diacanthomantis*
4. Two small tubercles on anterior border of pronotum. *Hapalopeza*
- Anterior border of pronotum without tubercles. 5
5. Antennae coarse. Frontal sclerite not transverse, the superior border very curved.
. *Spilomantis*
- Antennae fine. Frontal sclerite transverse. *Iridopteryx*
6. Elytra of male very large *Pilomantis*
- Elytra of male very short. 7
7. Pronotal bulge large and well defined, the pronotum almost cross-shaped.
. *Calofulcinia*
- Pronotal bulge not well defined. 8
8. Anterior tibia with 8-9 external spines, more or less equally spaced. . . *Fulciniella*
- Anterior tibia with 7 external spines, the basal well separated from the others. . . 9
9. Inferior ocellar tubercle sharp. *Fulcinia*
- Inferior ocellar tubercle simple. 10
10. Costal area of elytra traversed by small parallel veins. *Nanomantis*
- Costal area of elytra irregularly veined. *Tylomantis*
- * Also included by Gigilo-Tos: *Hapalopezella* (very similar to *Hapalopeza*), *Fulciniola*,
Diapfulcinia, *Oxyfulcinia*, *Profulcinia*, all Gigilo-Tos.
- * Also included by Beier: *Nemotha* Wood-Mason, *Shirakia* Beier, *Rawarena* Tindale, *Ima*
Tindale, *Sinomantis* Beier, *Papugalepsus* Werner.
- * Also included by both Gigilo-Tos and Beier: *Sceptuchus* Hebard.
- * Beier moves *Ciulfina* and *Stenomantis* to Liturgusinae.

Tribe Tropidomantini

Key to genera

1. Pronotal keel crenellated. *Enicophlebia*
- Pronotal keel smooth. 2
2. Mediastinal vein adjacent to anterior radial vein; no transverse venules between these
veins. 3
- Mediastinal vein more or less distant from anterior radial vein; small venules present
between these veins. 9

3. Elytra short, barely longer than the pronotum. *Nilomantis*
 [Probably includes *Cryptomantis* Gigilo-Tos, and *Ilomantis* Gigilo-Tos]
 - Elytra large. 4
 4. Anterior tibia with 11-13 external spines. 5
 - Anterior tibia with less than 11 external spines.
 5. Summit of vertex flat, not raised above the eyes, without tubercles next to the eyes.
 *Hyalomantis*
 - Summit of vertex rounded and raised above the eyes, round tubercles next to the
 eyes. *Platycalymma*
 6. Sixth external tibial spine from the tip longer than the fifth. 7
 - Sixth external tibial spine from the tip not longer than the fifth. 8
 7. Pronotum shorter than anterior coxa. *Tropidomantis*
 - Pronotum at least as long as anterior coxa. *Negromantis*
 8. Cells on elytra with opaque spot in the middle. *Neomantis*
 - Cells on elytra without opaque spot. *Melomantis*
 9. Costal area of elytra large and irregularly reticulated. *Chiromantis*
 - Costal area of elytra short, with parallel veins. 10
 10. Costal area of elytra opaque. *Xanthomantis*
 - Costal area of elytra hyaline. *Miromantis*
- * Also included by both Beier and Giglio-Tos: *Kongobatha* Hebard.
- * Also included by Giglio-Tos: *Epsomantis* Gigilo-Tos (but put in Iridopterygini by Beier),
Eomantis Gigilo-Tos, *Mimomantis* Gigilo-Tos, *Ormomantis* Gigilo-Tos, and
Pliacanthopus Gigilo-Tos.

Subfamily Liturgusinae

Key to genera

1. Pronotum in form of heraldic shield, edges more or less dilated anteriorly. 2
 - Pronotum with edges parallel or convergent anteriorly. 5
 [Above couplet deduced from Gigilo-Tos and may be incorrect.]
2. Costal area of elytra as wide as half the discoidal area. *Theopompa*
 [Probably includes *Theopompella* Gigilo-Tos]
 - Costal area of elytra much narrower than half the discoidal area. 3
3. Edges of pronotum with spines. *Zouza*
 - Edges of pronotum without spines. 4

4. Pronotum almost as wide as long. Female elytra very short. *Elaea*
 [*Elaea* transferred to *Amelinae* by Ragge and Roy, 1967]
- Pronotum much longer than wide. Female elytra at least as long as abdomen.
 *Humbertiella*
 [Probably includes *Theopompula* Gigilo-Tos]

5. Three discoidal spines. 6
- Four discoidal spines. 7

6. Four posterior femora spined inferiorly. *Ciulfina*
- Four posterior femora simple. *Stenomantis*

7. Discoidal spines placed in a straight line. 8
- Discoidal spines placed in a zigzag. 12

8. Pronotum without tubercles. *Liturgusella*
- Pronotum with 2 tubercles on the anterior part of the metazone. 9

9. Posterior femora with lobule or tooth inferiorly near tip. 10
- Posterior femora simple. 11

10. Vertex without projection above ocelli. *Majanga*
- Vertex with projection above ocelli. *Majangella*

11. Internal apical lobes of anterior coxa divergent. *Melliera*
- Internal apical lobes of coxa contiguous. *Mellierella*

12. Supra-anal plate small, transverse. 13
- Supra-anal plate large, covering the tip of the abdomen. 14

13. Top of vertex with tubercles next to eyes. *Dactylopteryx*
 [Probably includes *Phloeomantis* Gigilo-Tos]
- Top of vertex without tubercles. *Gonatistella*

14. Anterior tibia with 6 external spines. Discoidal vein of wings bifurcate. . . *Gonatista*
- Anterior tibia with 7-8 external spines. Discoidal vein of wings simple. 15

15. Anterior tibia with 7-8 external spines, the sixth from the apex much longer.
 *Liturgusa*
- Anterior tibia with 8 external spines, the sixth not longer. *Hagiomantis*

Subfamily Mantinae

The keys to this subfamily will appear in the *MSG Newsletter* number 3 in February 1997.

Subfamily Oligonychinae

Key to tribes

1. Pronotum straight. Abdominal segments of female without lobe-shaped projections.
..... Oligonychini
- Pronotum bent in side-view. Abdominal segments of female with lobes.
..... Pogonogasterini

Tribe Oligonychini

Key to genera

1. Pronotum short, diamond shaped. *Bantia*
[synonyms *Eubantia* and *Mionicella*]
- Pronotum much longer than broad. 2
2. Anterior tibia with external marginal spines in addition to the apical.
..... *Pseudomusonia*
[synonyms: *Eumionyx* and *Mionyx*]
- Anterior tibia with only an apical external marginal spine. 3
3. Anterior femora with 4 discoidal spines. 4
- Anterior femora with 3 discoidal spines. 6
4. Metazone of pronotum longer or as long as anterior coxa. *Bactromantis*
- Metazone of pronotum much shorter than anterior coxa. 5
5. Supra-anal plate elongate, lanceolate. *Oligonicella*
- Supra-anal plate short, triangular. *Thrinaconyx*
6. Vertex with protuberance below the ocelli. *Thesprotiella*
- Vertex without protuberance. 7
7. Anterior tibia with several internal marginal spines as well as the apical and the dorsal. *Oligonyx*
- Anterior tibia without internal marginal spines; apical and dorsal spines only.
..... *Thesprotia*

Tribe Pogonogasterini

Key to genera

1. Bifurcate frontal process present. Supra-coxal expansion of pronotum without foliaceous lateral expansions. *Carrikerella*
- No frontal process. Supra-coxal expansion with lateral foliaceous expansions.
..... *Pogonogaster*

Subfamily Orthoderinae

Contains only two genera: *Orthodera* and *Orthoderina*.

Subfamily Oxythestinae

Key to genera

1. Pronotum more than two times as long as the anterior coxa. *Acithespis*
- Pronotum not twice as long as anterior coxa. 2
2. External spines of anterior femora more or less of the same length. . . . *Oxythestina*
- Second external spine of anterior femora longer than the rest. *Heterochaetula*

Subfamily Photininae

Key to tribes

1. Anterior femora with 3 discoidal spines. Coptopterygini
- Anterior femora with 4 discoidal spines. Photinini

Tribe Coptopterygini

Key to genera

1. Middle femur much longer than anterior coxa. 2
- Middle femur as long or shorter than anterior coxa. 3
2. Antennae thin, not bulbous at base. Pronotum thick, the metazone more or less as long as the anterior coxa. *Coptopteryx*
- Antennae bulbous at base. Pronotum very thin, the metazone much longer than the anterior coxa. *Brunneria*
3. Conical tubercle on each side next to eye on top of vertex. Eyes small, not bulging. *Orthoderella*
- No tubercles next to eyes. Eyes large, protruding. *Paraphotina*

* Beier also includes *Cardioptera* Burmeister (placed in Vatininae by Gigilo-Tos).

Tribe Photinini

Key to genera

1. Internal apical lobes of anterior coxa adjacent. *Macromantis*
- Internal apical lobes of anterior coxa divergent. 2
2. Costal region of elytra of male partially opaque, traversed by parallel veins but with irregular branches. Costal region of elytra of female irregularly veined. . . *Photinella*
- Costal region of elytra of male hyaline, traversed by spaced parallel simple veins. Costal region of elytra of female traversed by numerous parallel veins. 3
3. Frontal sclerite scarcely 2 or 2 ½ times as broad as high. *Photina*
- Frontal sclerite very transverse, at least 4 times as broad as high. *Hicetia*

* Gigilo-Tos also includes *Metriomantis* Saussure & Zehntner.

* Beier also includes *Microphotina* Beier.

Subfamily Phyllotheliinae

Key to genera

1. Frontal sclerite pentagonal, with two keels or tubercles. *Phyllothelis*
- Frontal sclerite triangular, the disc traversed by 5 keels. *Ceratocrania*

Subfamily Schizocephalinae

Contains only a single genus *Schizocephala*.

Subfamily Sibyllinae

Key to genera

1. Posterior angles of abdominal segments prolonged into filiform lobes. . . *Presibylla*
- Abdominal segments simple, not prolonged into filiform lobes. *Sibylla*

* Also included by Giglio-Tos, but not Beier: *Arria*.

Subfamily Tarachodinae

Key to genera

1. Claw groove very near base of anterior femur. 2
- Claw groove more or less distant from base of anterior femur. 10
2. Anterior coxa jutting out beyond posterior border of pronotum. 3
- Anterior coxa not jutting out beyond posterior border of pronotum. 8
3. Eyes conical. *Charieis*
- Eyes rounded. 4
4. Anterior tibia with 8-9 external spines. 5
- Anterior tibia with more than 9 external spines. 6
5. Supra-anal plate large, almost as long as broad, the tip rounded. *Antistia*
- Supra-anal plate short, transverse. *Ariusa*
6. Anterior metatarsi and cerci cylindrical. *Tarachodella*
- Anterior metatarsi and cerci compressed. 7
7. Four posterior femora rounded. *Tarachodula*
- Four posterior femora compressed. *Tarachodes*
8. Top of vertex excavated, the eyes jutting out beyond the vertex. . . *Oxyophthalmellus*
- Top of vertex convex or flat, the eyes not jutting out beyond the vertex. 9
9. Elytra of male as long, or nearly as long, as the abdomen. Pronotum of female without tubercles. *Galepsus*

- Elytra of male short, not exceeding the middle of the abdomen. Pronotum of female with two blunt tubercles behind the supra-coxal groove. *Paralygdamia*
 - 10. Centre of apex of vertex prolonged in a triangular protuberance. (Not two adjoining juxta-ocular lobes with similar appearance, c.f. *Didymocorypha*) . . . *Pyrgomantis*
 - Centre of apex of vertex not prolonged. 11
 - 11. Lateral lobes of apex of vertex protruding more or less beyond the superior border of the eyes. 12
 - Lateral lobes of apex of vertex not protruding beyond superior border of the eyes. 13
 - 12. Lateral lobes of vertex only protruding a little beyond the eyes.
. *Oxyophthalma*
 - Lateral lobes of vertex protruding considerably beyond the eyes and forming a triangular process similar to *Pyrgomantis* but split at the tip. *Didymocorypha*
 - 13. Anterior femora dilated, the superior border straight or a little bowed. 14
 - Anterior femora thin, the superior border a little concave. 15
 - 14. Eyes without spines. *Paroxyophthalmus*
 - Eyes terminating in a long spine. *Episcopus*
[? equivalent to Beier's *Episcopomantis*]
 - 15. Eyes rounded. *Dysaules*
 - Eyes pointed. *Parepiscopus*
- * Beier also includes *Oxyelaea* Gigilo-Tos in Tarachodinae.

Subfamily Thespinae

Key to tribes

- 1. Three discoidal spines. Hoplocoryphini
- Four discoidal spines. 2
- 2. Eyes projecting anteriorly in an obtuse cone. Parathespini
- Eyes round. 3
- 3. Anterior femora very thin. Thespini
- Anterior femora expanded. Pseudomiopterygini

Tribe Hoplocoryphini

Key to genera

- 1. Length of metazone of pronotum almost double that of anterior coxa. Antenna of female thickened at the base. *Hoplocoryphella*
- Length of metazone of pronotum less than double that of the anterior coxa. Antenna of female not thickened at the base. *Hoplocorypha*

Tribe Parathespini

Single genus: *Parathespis*.

Tribe Thespini

Key to genera

1. Anterior tibia with 2-3 external spines. *Galapagia*
- Anterior tibia with 5 external spines. 2
2. Anterior coxa much longer than metazone of pronotum. 3
- Anterior coxa as long or shorter than metazone of pronotum. 5
3. Supra-anal plate long, extending beyond cerci. *Eumusonia*
- Supra-anal plate short, not extending beyond cerci. 4
4. Metazone of pronotum smooth. *Musoniella*
- Metazone of pronotum with two tubercles. *Musoniola*
5. Elytra and wings of male pointed at the end. *Leptomiopteryx*
- Elytra and wings of male rounded at the end. 6
6. Anterior coxa as long as metazone of pronotum. *Musonia*
- Anterior coxa shorter than metazone of pronotum. 7
7. Lobes next to eyes on summit of vertex elevated above the rest. Pronotum very thin.
. *Paramusonia*
- Lobes next to eyes on summit of vertex not elevated above the rest. Pronotum less
thin. *Thespis*

* Beier also includes *Macromusonia* Hebard (synonym of *Catamusonia* Gigilo-Tos).

Tribe Pseudomiopterygini

Key to genera

1. Anterior coxa without small lobe at anterior border. 2
- Anterior coxa with small lobe at anterior border. 5
2. Summit of vertex bosselated next to eye. Prozone of pronotum wide, squarish.
. *Eumiopteryx*
- Summit of vertex not bosselated. Prozone of pronotum thin. 3
3. Wings with pointed tip, the posterior apical border of discoidal area a little concave.
. *Promiopteryx*
- Wings with rounded tip, the posterior apical border of discoidal area convex. . . . 4
4. Anterior part of costal area of elytra irregularly veined. *Antimiopteryx*
- Anterior part of costal area of elytra with spaced parallel veins. . . *Chloromiopteryx*

5. Pronotum short, lozenge shaped. 6
- Pronotum linear, much longer than wide. 9
6. Pronotal disc smooth. 7
- Pronotal disc with tubercles. 8
7. Anterior tibia with 6-7 external spines. *Diabantia*
- Anterior tibia with 3-4 external spines. *Mantillica*
8. Posterior legs of female cylindrical. *Pseudomiopteryx*
- Posterior legs of female very compressed. *Anamiopteryx*
9. Inferior ocellar tubercle sharp; female winged. *Mantellias*
- Inferior ocellar tubercle simple; female apterous. 10
10. External spines of anterior tibia equally spaced. *Bantiella*
- Seventh external spine from end of anterior tibia much displaced. *Miobantia*

Subfamily Toxoderinae

Key to tribes

1. Anterior tibia compressed, dilated, with spines along entire length. *Stenophyllini*
- Anterior tibia thin, with only distal spines. *Toxoderini*

Tribe Stenophyllini

Contains a single genus: *Stenophylla*.

Tribe Toxoderini

Key to genera

1. Anterior coxae expanded into a lobe at their ends. 2
- Anterior coxae not expanded into a lobe at their ends. 5
2. Cerci short, the end not bifid. *Toxoderella*
- Cerci long, the end bifid. 3
3. The four posterior femora without an apical spine. *Paradanuria*
- The four posterior femora with an apical spine. 4
4. Vertex simple. *Euthyphleps*
- Vertex with protuberance in the middle. *Toxoderopsis*
5. Eyes armed with a spine on top. 6
- Eyes not armed with a spine. 9
6. Cerci with bifid end. *Toxodera*
- Cerci not bifid, rounded or truncated at the end. 7

7. Four posterior femora lobed. *Paratoxodera*
- Four posterior femora without lobes. 8
 8. Vertex extending beyond eyes. Posterior tibiae with keels, almost forming lobes.
. *Oestomantis*
- Vertex not extending beyond eyes. Posterior tibiae without keels. *Toxomantis*
 9. Vertex without spines in the middle. *Loxomantis*
- Vertex with two spines in the middle. 10
 10. Anterior femora with 5 external spines. *Dorymantis*
- Anterior femora with 7 external spines. 11
 11. Cerci long. The lateral geniculate lobes of the middle femur long, spinous.
. *Belomantis*
- Cerci short, broad. The lateral geniculate lobes of middle femur short, triangular.
. *Calamothespis*
- * Beier also includes *Aethalochroa* Wood-Mason (placed in Vatinae by Gigilo-Tos), *Cheddikulama* Henry, *Pareuthyphleps* Werner.

Subfamily Vatinae

Key to tribes

1. Anterior coxa with distal lamelliform expansion. Danuriini
- Anterior coxa without distal expansion. 2
2. Cerci compressed, foliaceous. Heterochaetini
- Cerci cylindrical. 3
3. Head without projections. Stigmatopterini
- Head with prolonged ocellar tubercles. Vatini

Tribe Danuriini

Key to genera

1. Anterior femora with triangular lobe on superior border before the end. *Popa*
[Probably also includes *Macropopa* Gigilo-Tos]
- Anterior femora without lobe on superior border before the end. 2
2. Middle tibiae without inferior lobe. *Danuria*
- Middle tibiae with superior and inferior lobes. *Macrodanuria*

- * Beier includes *Danuriella* Westwood, although description in Gigilo-Tos says no coxal expansion.

Tribe Heterochaetini

Contains a single genus: *Heterochaeta*.

Tribe Stagmatopterini

Key to genera

1. Eyes laterally more or less conical. 2
- Eyes rounded. 5
2. Lateral borders of pronotum armed in the metazone with very long spines.
. *Catoxyopsis*
- Lateral borders of pronotum smooth or only slightly toothed. 3
3. Posterior femora lobed. *Paroxyopsis*
- Posterior femora not lobed. 4
4. Eyes sharp. Anterior coxa do not reach the base of the prosternum. *Oxyopsis*
- Eyes blunt. Anterior coxa reach base of prosternum. *Pseudoxyopsis*
5. Pronotum with tubercles on the supracoxal bulge. *Heterovates*
- Pronotum without tubercles on supracoxal bulge. 6
6. Four posterior femora lobed. *Lobocneme*
- Four posterior femora not lobed. 7
7. Frontal sclerite a little broader than tall. *Stagmatoptera*
- Frontal sclerite narrowed transversely. 8
8. Pronotum about twice as long as anterior coxa. *Leptochoche*
- Pronotum not twice as long as anterior coxa. *Parastagmatoptera*

* Gigilo-Tos also includes *Ardesca* Stål, and *Chopardiella* Gigilo-Tos.

Tribe Vatini

Key to genera

1. Anterior femora with superior preapical lobe. *Zoolea*
- Anterior femora without superior preapical lobe. 2
2. Four posterior legs lobed. *Vates*
- Four posterior legs without lobes. 3
3. Fourth abdominal segment dilated laterally in a lobe. Pronotum short. . . *Hagiotata*
- Fourth abdominal segment not lobed. Pronotum long. *Phyllovates*

* Gigilo-Tos also includes *Pseudovates* Saussure, and *Austrovates* Sjöstedt.

Mantis abstracts

The following are abstracts from papers published recently. The papers are in English unless otherwise indicated. The editor would be grateful for copies of any recently published papers so that abstracts may be included in this section of the newsletters.

Fagan, W.F. & Odell, G.M. (1996) Size-dependent cannibalism in praying mantids: Using biomass flux model size-structured populations. *American Naturalist*, **147**(2): 230-268.

Here we investigate how cannibalism, a widespread phenomenon in nature, influences the population dynamics and the differential success of emergence-timing strategies in praying mantids. Relying on an extraordinarily complete data set describing the ecophysiology of a single mantid species, we construct a size-structured model based on "biomass flux" to study how size-dependent cannibalism influences this species' population ecology. Further, we demonstrate how this model accurately predicts mantid developmental patterns under both laboratory and field conditions. We conclude that for mantids, and perhaps generalist ambush predators overall, descriptions of biomass flux can be satisfactorily used to model growth without explicit reliance on encounter rate terms. In particular, this autecological approach to modelling size-structured interactions provides a method for revealing how sensitively development hinges on small differences in emergence time.

Lombarfdo, F. (1995) A review of the genus *Popa* Stål 1856 (Insecta Mantodea). *Tropical Zoology*, **8**(2): 257-267.

It is suggested that *Mantis undata* Fabricius, 1793 does not belong to the genus *Popa* Stål, 1856 as believed until now, but to the Indian genus *Ambivia* Stål, 1877 (n. comb.). The systematic position of the species of *Popa* is re-examined and a single species, *Popa spurca* Stål, 1856 (= *P. undata* auct. nec Fabricius) is recognised. The species is differentiated into two subspecies, one being *Popa spurca spurca* Stål, 1856 (= *P. stuhlmanni* Rehn, 1914, *P. batesi* Saussure & Zehntner, 1895) (n. syn.) widespread throughout all Africa south of the Sahara, except in the east which is populated by the other subspecies, *P. spurca crassa* (Giglio-Tos, 1917).

Prete, F.R. & McLean, T. (1996) Responses to moving small-field stimuli by the praying mantis, *Sphodromantis lineola* (Burmeister). *Brain Behavior and Evolution*, **47**(1): 42-54.

Adult, female praying mantises, *Sphodromantis lineola* (Burmeister), were presented with mechanically driven or computer generated stimuli in a series of seven experiments in order to test several hypotheses regarding visual prey recognition. When presented with a series of square black and white computer generated stimuli against a white background, mantises performed the highest rates of predatory behaviour in response to those stimuli with a greater proportion of black versus white pixels (i.e., those that produced larger luminance decrements). Higher response rates to computer generated stimuli that produced larger luminance decrements were also seen when the stimuli were irregularly shaped or consisted of two small synchronized stimuli. Mantises responded characteristically to mechanically driven stimuli that were camouflaged to match the background against which they moved, preferring small (vs. large) squares and rectangles that were elongated parallel (vs. perpendicular) to their direction of movement. Finally, response rate to a small, preferred, mechanically presented or computer generated stimulus was suppressed by a concurrent large-

field stimulus in inverse proportion to the distance between the two stimuli. This phenomenon is characteristic of systems that include phasic lateral inhibitory circuits. All of these results are consistent with the existence of a movement detector visual sub-system, as found in other orthopteromorph insects such as acridid grasshoppers and cockroaches.

Rooney, T.P., Smith, A.T. & Hurd, L.E. (1996) Global warming and the regional persistence of a temperate-zone insect (*Tenodera sinensis*). *American Midland Naturalist*, **136**(1): 84-93.

Models based on the paleoecological record predict that animals in temperate regions will respond to global warming by migrating poleward to remain within their temperature tolerance ranges. The effect of global warming on invertebrates is of great concern because of their critical role in ecosystem structure and function. Migration poses a problem for many species because of their limited dispersal abilities. The life cycle of a typical temperate zone univoltine insect, *Tenodera sinensis* (Mantodea: Mantidae) is constrained by degree-days per season: too few prevent maturation before the killing frost in the autumn; too many allow egg hatch before a killing frost. The used field and laboratory observations on the life history and ecology of this species to predict the effect of global warming on the regional distribution of this insect by the end of the next century. Based on the simplified, best-case, biological assumptions of our model, the geographical range of *T. sinensis* in eastern North America would be compressed toward the northern part of its present contiguous regional distribution. This and other univoltine temperate species with long maturation periods and low vagility could face regional extinction if global warming predictions are accurate.

Terra, P.S. (1995) Systematics of the neotropical genera of praying mantis (Mantodea). *Revista Brasileira de Entomologia*, **39**(1): 13-94. [in Portuguese].

The Neotropical genera of praying mantis are revised. Seventy four genera are recognized and grouped in six families. A key to the Neotropical families, subfamilies and genera is presented. New taxa: *Raptrix* gen. n. (Acanthopidae, Acontistinae); Antemninae, subfam. n. (Vatidae). New synonyms proposed: Hymenopodidae Chopard, 1949 = Acanthopidae Burmeister, 1838; *Acontistella* Beier, 1929 and *Metaphotina* Piza, 1964 = *Acontista* Saussure, 1869 (Acanthopidae, Acontistinae); Epaphroditinae Giglio-Tos, 1919 = Acanthopinae Burmeister, 1838 (Acanthopidae); *Decimia* Stål, 1877 (non Walker, 1856) and *Decimiana* Uvarov, 1940 = *Acanthops* Serville, 1831 (Acanthopidae, Acanthopinae); *Navimons* Piza, 1970 = *Leptomiopteryx* Chopard, 1912 (Thespidae, Pseudomiopteriginae); *Navimons amapaensis* Piza, 1970 = *Leptomiopteryx dispar* Chopard, 1912. *Trachymiopteryx* Rehn, 1920 = *Anamiopteryx* Giglio-Tos, 1915 (Thespidae, Pseudomiopteriginae); *Piracicaba* Piza, 1967 = *Eumiopteryx* Giglio-Tos, 1915 (Thespidae, Pseudomiopteriginae); *Cnephomantis* Rehn, 1920 and *Antimiopteryx* Giglio-Tos, 1927 = *Miobantia* Giglio-Tos, 1917 (Thespidae, Miopteryginae); *Metathespis* Piza, 1968 = *Chloromiopteryx* Giglio-Tos, 1915 (Thespidae, Miopteryginae); *Metathespis modesta* Piza, 1968 and *Metathespis precaria* Piza, 1968 = *Chloromiopteryx thalassina* (Burmeister, 1838); *Oligonichinae* Beier, 1964 = *Oligonicinae* Giglio-Tos, 1919 (Thespidae); *Paradiabantia* Piza, 1963 = *Diabantia* Giglio-Tos, 1915 (Thespidae, Oligonicinae); *Mionycoides* Rehn, 1935 = *Pseudomusonia* Werner, 1925 (Thespidae, Oligonicinae); *Isomantis* Giglio-Tos, 1917 = *Stagmomantis* Saussure, 1869 (Vatidae, Stagmomantinae); *Tauromantis* Giglio-Tos, 1917 = *Phasmomantis* Saussure, 1869 (Vatidae, Stagmomantinae); *Photiomantis* Piza, 1968 = *Photinella* Giglio-Tos, 1915 (Vatidae, Photininae); *Guaraunia* Rehn, 1941 = *Paraphotina* Giglio-Tos, 1915 (Vatidae, Photininae);

Brachypteromantis Piza, 1960 = *Coptopteryx* Saussure, 1869 (Vatidae, Photininae). New combinations proposed: *Acontista amazonica* (Beier, 1927); *Acontista ecuadorica* (Hebard, 1924); *Acontista irioides* (Hebard, 1922); *Acontista piracicabensis* (Piza, 1964); *Acontista travassosi* (Jantsch, 1986); *Raptrix fusca* (Olivier, 1792); *Raptrix fuscata* (Stoll, 1813); *Raptrix perspicua* (Fabricius, 1787); *Anamiopteryx tuberculata* (Rehn, 1920); *Eumiopteryx bicentenaria* (Piza, 1967); *Musoniella fragilis* (Piza, 1965); *Miobantia ciliata* (Stål, 1850); *Miobantia fuscata* (Giglio-Tos, 1915); *Miobantia nebulosa* (Giglio-Tos, 1915); *Miobantia phryganea* (Saussure, 1869); *Miobantia rustica* (Fabricius, 1781); *Diabantia perparva* (Piza, 1973); *Bantia nana* (Piza, 1969); *Bantia simoni* (Chopard, 1912); *Pseudomusonia fera* (Saussure & Zehntner, 1894); *Stagmomantis amazonica* (Jantsch, 1985); *Stagmomantis domingensis* (Beauvois, 1805); *Stagmomantis paraensis* (Jantsch, 1985); *Photinella silvai* (Piza, 1968); *Paraphorina insolita* (Rehn, 1941); *Coptopteryx precaria* (Piza, 1966).

Terra, P.S. (1996) Sexual behaviour of *Cardioptera brachyptera* (Mantodea). *Revista Brasileira de Entomologia*, **40**(1): 3-7. [in Portuguese].

The courtship and mating behaviour of the neotropical praying mantis *Cardioptera brachyptera* Burmeister (Vatidae, Photininae) are described based on wild males attracted by nine captive females kept inside field enclosures. The enclosures were removed and the males allowed to see the females. The male courtship behaviour comprises the following sequence: 1, focusing the female; 2, rhythmic lateral abdominal swingings; 3, spreading of tegminae and wings; 4, approaching the female (displaying the abdominal swingings and spreading tegminae and wings); 5, jump on the dorsum of the female; 6, adopting the copulatory posture; 7, intromission. Copulation lasted in average about 6h. Immediately after mating males flew away. No active courtship by females was observed; they remained motionless, displaying the prey capture posture. One successful mating was observed without pre-copulatory display. One female attracted simultaneously three males and mated with all of them. Sexual cannibalism was not observed.

Terra, P.S. (1996) Maternal care in *Photina amplipennis* Stål. (Mantodea, Vatidae). *Revista Brasileira de Entomologia*, **40**(1): 9-10. [in Portuguese].

Egg care was observed in two females of the neotropical praying mantis *Photina amplipennis* Stål (Photininae). The female rests on the top of her ootheca throughout the incubation period. For a few days after emergence the nymphs and the female stay near the ootheca.

Yager, D.D. (1996) Nymphal development of the auditory system in the praying mantis *Hierodula membranacea* Burmeister (Dictyoptera, Mantidae). *Journal of Comparative Neurology*, **364**(2): 199-210.

Like other praying mantises, *Hierodula membranacea* has a single midline ear on the ventral surface of the metathorax. The ear comprises a deep groove with two tympana forming the walls. A tympanal organ on each side contains 30-40 scolopophorous sensillae with axons that terminate in the metathoracic ganglion in neuropil that does not match the auditory neuropil of other insects. Nymphal development of the mantis ear proceeds in three major stages: 1) The tympanal organ is completely formed with a full complement of sensillae before hatching; 2) the infolding and rotations that form the deep groove are completed primarily over the first half of nymphal development; and 3) over the last five instars (of ten), the tympana thicken and broaden to their adult size and shape, and the impedance-matching

tracheal sacs also enlarge and move to become tightly apposed to the inner surfaces of the tympana. Auditory sensitivity gradually increases beginning with the fifth instar and closely parallels tympanum and tracheal sac growth. Late instar nymphs have auditory thresholds of 70-80 dB sound pressure level (SPL). Appropriate connections of afferents to a functional interneuronal system are clearly present by the eighth instar and possibly much earlier. The pattern of auditory system ontogeny in the mantis is similar to that in locusts and in noctuid moths, but it differs from crickets. In evolutionary terms, it is significant that the metathoracic anatomy of newly hatched mantis nymphs matches very closely the anatomy of the homologous regions in adult cockroaches, which are closely related to mantises but are without tympanal hearing, and in mantises that are thought to be primitively deaf.

Yager, D.D. (1996) Serially homologous ears perform frequency range fractionation in the praying mantis, *Creobroter* (Mantodea, Hymenopodidae). *Journal of Comparative Physiology. A. Sensory Neural and Behavioral Physiology*, **178**(4): 463-475.

Unlike most praying mantises that have a single region of auditory sensitivity, species in the genus *Creobroter* have equally sensitive hearing at 2-4 and at 25-50 kHz and are relatively insensitive at 10-15 kHz - they have a W-shaped audiogram. Ultrasonic sensitivity originates from an auditory organ in the ventral midline of the metathorax that closely resembles the ear of other mantises. Ablation experiments demonstrate that low frequency sensitivity derives from a serially homologous mesothoracic auditory organ. Extracellular recordings suggest that these two ears operate largely, if not entirely, independently of one another in the thorax. The low frequency response has a longer latency, more action potentials per stimulus, and different patterns of change with increasing SPL than the high frequency response. Separate interneurons mediate responses in the two frequency ranges, but our evidence suggests that they are two serially homologous sets of cells. Neither auditory organ shows any physiological evidence of directional sensitivity. Ultrasound triggers a set of behaviours in flying hymenopodid mantises much like those in other mantises, but the behavioral significance of low frequency hearing in these animals is still unknown.

Cockroaches

Interested in cockroaches? The Blattodea Culture Group produces a newsletter for people interested in culturing cockroaches. For further information contact: The Blattodea Culture Group, c/o Adrian Durkin, 8 Foley Road, Pedmore, Stourbridge, West Midlands, DY9 0RT, U.K.

Stick insects

Interested in stick insects? The Phasmid Study Group produces a newsletter and a journal for people interested in phasmids. The group has a livestock co-ordinator and regular meetings. There are about 500 members worldwide. For further details contact the Membership secretary: Paul Brock, 40 Thorndike Road, Slough, Berks, SL2 1SR, U.K.